

# The Marin Countywide Plan

## Environmental Quality Element Technical Report #1 Air Quality in Marin County



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## EXECUTIVE SUMMARY

Technical Report #1, Air Quality Maintenance in Marin County provides background and data for the policies and implementation measures in the Environmental Quality Element of the Marin Countywide Plan. These policies and programs are designed to bring local policy in line with the regional attainment targets of the regional Bay Area '91 Clean Air Plan (CAP). Due to favorable meteorological conditions in Marin County and the absence of heavy industry, the ambient air quality throughout the county is excellent. Marin County emission of contaminants, primarily from transportation sources, is a concern at "sensitive receptor" sites and contributes to the regional air quality problem.

The authority for air quality planning rests primarily with the Federal and State governments, which have each set standards for the five most prevalent pollutants: 1) carbon monoxide, 2) ozone, 3) nitrogen dioxide, 4) sulfur dioxide, and 5) total suspended particulates. The California Air Resources Board implements the State's vehicle emission control regulations through vehicle registration. Regional agencies are responsible for planning for attainment of air quality standards and implementing State and Federal air quality regulations. Regional air quality planning is the joint responsibility of the Bay Area Air Quality Management District (BAAQMD), the Association of Bay Area Governments (ABAG), and the Metropolitan Transportation Commission (MTC).

The California Clean Air Act of 1988 substantially increased the authority of BAAQMD. The agency adopted the Bay Area '91 Clean Air Plan, designed to bring the region into compliance with State carbon monoxide and ozone standards. BAAQMD regulates all stationary sources of air pollution in the Bay Area. The Bay Area '91 Clean Air Plan calls for indirect source control which may result in BAAQMD permits or regulations for large attractors of motor vehicles. The agency issues permits for industrial plants and other direct emission sources.

BAAQMD identifies "sensitive receptors" as facilities with concentrations of individuals who are highly susceptible to the adverse effects of air pollutants. These facilities include hospitals, clinics, schools, playgrounds, child care centers, and convalescent and retirement homes. Residential areas can be considered sensitive receptors as well, since they are occupied by many children and elderly persons. In Marin County, the proximity of some sensitive receptors to heavily traveled roads may expose these populations to unhealthy concentrations of carbon monoxide and other pollutants especially during and after commute rush hours. Almost 100 specific sensitive receptors have been identified in unincorporated Marin County, although every residential area could qualify as a sensitive receptor.



Air quality in most of Marin County is already well within national and State standards. The coastal climate affecting Marin is largely responsible for the dispersion of pollutants generated in the county. The absence of heavy industry in the county minimizes industrial pollutants. The county's topography, a series of low ridges with an east-west alignment, corresponds to the primary direction of coastal winds. The combination allows for constant scouring of the ambient air in the heavily populated valleys. However, dispersion of local emissions contributes to regional air quality problems.

Temperature inversions (i.e., when cooler temperatures occur near the ground and warmer temperatures occur at 500 feet or higher) occasionally result in a visible layer of pollution containment. Inversions limit dispersion of air pollution and can lead to elevated concentrations of ozone in the summer and carbon monoxide in the winter.

The recommended policies and programs call for the County's compliance with Federal, State, and regional air quality standards and cooperation with other agencies to enforce provisions of the Clean Air Acts and Bay Area '91 Clean Air Plan. County policy also considers the potential air pollution impacts and odors of all proposed projects, including effects on sensitive receptor populations. Lastly, the proposed policies would commit the County to a transportation program which serves to reduce congestion and single occupant commuting so as to reduce pollutants generated by internal combustion engines of motor vehicles.

## I. BACKGROUND AND PURPOSE

Technical Report #1, Air Quality Maintenance in Marin County provides background and data for the policies and implementation programs in the Environmental Quality Element of the Marin Countywide Plan. These policies and programs are designed to bring local policy in line with the regional attainment targets of the Bay Area '91 Clean Air Plan (CAP).

The National Clean Air Act was signed into law by Congress and the President in 1970. Under the requirements of Public Law 88-206, the Environmental Protection Agency (EPA) establishes the National Ambient Air Quality Standards (see Table 1 for the most recent standards). These standards specify concentrations in parts per million for gases and micrograms per cubic meter for fine particulates of various pollutants that are not to be exceeded in the ambient (outdoor) air more than one time per year. The standards also specify a time period for averaging the standard concentration of ambient air pollutants.

Many agencies are involved in air pollution control in the Bay Area, including the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (ARB), and the Bay Area Air Quality Management District (BAAQMD). The responsibilities of these agencies have recently changed as a result of two new laws:

- The Federal Clean Air Act Amendments of 1990; and
- The California Clean Air Act of 1988;

The implementation of programs to achieve air quality standards is accomplished largely through Federal, State, and regional air quality management plans and regulations.

### A. THE ENVIRONMENTAL PROTECTION AGENCY AND FEDERAL CLEAN AIR ACT

The EPA's traditional responsibilities in air quality management have included establishing national ambient air quality standards, requiring that air districts develop air quality plans to meet standards and impose sanctions when plans are not met, establishing mobile source controls, and developing guideline documents for controlling air emissions.

The original Federal Clean Air Act mandated the establishment of ambient air quality standards and required that areas in violation of these standards prepare and implement plans to achieve the standards by certain deadlines. The deadline for attaining both the ozone and CO standards was December 31, 1987. Areas that do not meet Federal



primary air quality standards are designated as nonattainment areas. Areas that comply with Federal air quality standards are designated attainment areas. Areas for which monitoring data is lacking are formally designated unclassified areas, but are generally treated as attainment areas. Attainment and nonattainment areas are pollutant specific. The Federal Clean Air Act Amendments of 1990 give the EPA additional authority to require states to reduce emissions of CO, and ozone precursors in nonattainment areas. The amendments set new attainment deadlines based on the severity of the problem. For example, the Bay Area must meet the Federal ozone standards by 1996.

#### B. THE STATE OF CALIFORNIA AIR RESOURCES BOARD (ARB)

Responsibilities of the Air Resources Board have traditionally included establishing State air quality planning, developing programs for reducing emissions from motor vehicles, developing air emission inventories, collecting air quality and meteorological data, and approving State implementation plans. For certain pollutants, State standards are more stringent than the Federal standards (see Table 1). The California Air Resources Board implements vehicle emission control regulations through requirements on manufacturers and through the Vehicle Inspection and Maintenance program.

#### C. THE CALIFORNIA CLEAN AIR ACT AND REGIONAL IMPLEMENTATION

Regional air quality planning is the joint responsibility of the Bay Area Air Quality Management District (BAAQMD), the Association of Bay Area Governments (ABAG), and the Metropolitan Transportation Commission (MTC). The Bay Area Air Quality Management District (BAAQMD) issues permits and administers regulations for industrial plants and other direct emission sources on behalf of the State and Federal governments. The District monitors and comments upon land use and transportation projects over certain threshold levels under the California Environmental Quality Act (CEQA) with the goal of ensuring appropriate impact analysis and adequate mitigation measures whenever these projects have significant air quality impacts (see Table 2).

The California Clean Air Act of 1988 substantially added to the authority and responsibilities of air districts like BAAQMD. The Act designates air districts as lead air quality planning agencies, requires that air districts prepare air quality plans, and grants air districts authority to implement transportation control measures. It focuses on attainment of the State ambient air quality standards which, for certain pollutants and averaging periods, are more stringent than Federal standards. The Act requires designation of attainment and nonattainment areas with respect to State ambient air quality standards.



Air districts are required to prepare an air quality attainment plan if the district violates State air quality standards for CO, sulfur dioxide, nitrogen dioxide, or ozone. No locally prepared attainment plans are currently required for areas that violate State P.M.10 standards. The State Clean Air Act requires State air quality standards to be met as expeditiously as possible, but does not set as precise attainment deadlines as the Federal Clean Air Act does. The State Act emphasizes the control of "indirect and areawide" sources of air pollutant emissions and gives local air pollution control districts explicit authority to regulate indirect sources of air pollution and to establish transportation control measures (TCMs).

In 1986, the governing board of BAAQMD adopted a resolution urging Bay Area cities and counties to include an Air Quality Element in their general plans (BAAQMD Resolution #1666). The purpose is to include air quality considerations in planning for land use and transportation development and in relationship to other general plan elements. While the Bay Area '91 Clean Air Plan charges BAAQMD with indirect source control, an air quality element or an equivalent ordinance will be a criterion for BAAQMD's delegation of indirect source control regulation to a jurisdiction.

Under State planning law, an air quality element is optional. The County has included its air quality discussion and policies in the Environmental Quality Element of the Countywide Plan, rather than in a separate element, in order to focus attention on air quality as an important local resource. This technical report provides information to support the policies and programs in the Environmental Quality Element.

Local air quality policies in a general plan do not require the approval of the Bay Area Air Quality Management District, the California Air Resources Board or the Environmental Protection Agency, although they should be in conformance with the spirit, goals, and technical standards outlined in the regional and State implementation plans.

On October 30, 1991, BAAQMD's Board of Directors adopted the Bay Area '91 Clean Air Plan. This plan, required by the California Clean Air Act of 1988, is designed to bring the region into compliance with State CO and ozone standards. BAAQMD's air quality attainment plan lists the region as a severe ozone area (compliance after 1997) and a moderate CO area (compliance by 1994). The Plan addresses stationary source control measures (SSCMs) and transportation control measures (TCMs). Mobile source controls differ from TCMs in that mobile source controls reduce the per-vehicle emissions for each mile driven, whereas TCMs seek to reduce the number of trips and miles traveled.



**Table 1. Comparison of Federal and State  
Ambient Air Quality Standards**

Pollutant	Symbol	Averaging Time	Standard, as parts per million		Standard, as micrograms per cubic meter		Violation Criteria	
			California	National	California	National	California	National
Ozone	O <sub>3</sub>	1 hour	0.09	0.12	180	235	If exceeded	If exceeded on more than 3 days in 3 years
Carbon monoxide	CO	8 hours	9.0	9	10,000	10,000	If exceeded	If exceeded on more than 1 day per year
(Lake Tahoe only)		1 hour	20	35	23,000	40,000		
		8 hours	6	--	7,000	--		
Nitrogen dioxide	NO <sub>2</sub>	Annual average	--	0.053	--	100	if exceeded	If exceeded
		1 hour	0.25	--	470	--		
Sulfur dioxide	SO <sub>2</sub>	Annual average	--	0.03	--	80	If exceeded	If exceeded If exceeded on more than 1 day per year
		24 hours	0.05	0.14	131	365		
		1 hour	0.25	--	655	--		
Hydrogen sulfide	H <sub>2</sub> S	1 hour	0.03	--	42	--	If equaled or exceeded	
Vinyl chloride	C <sub>2</sub> H <sub>3</sub> Cl	24 hours	0.010	--	26	--	If equaled or exceeded	
Particulate matter, 10 microns or less	PM10	Annual geometric mean	--	--	30	--	If exceeded	If exceeded If exceeded on more than 1 day per year
		Annual arithmetic mean	--	--	--	50		
		24 hours	--	--	50	150		
Sulfate particles	SO <sub>4</sub>	24 hours	--	--	25	--	If equaled or exceeded	
Lead particles	Pb	Calendar quarter	--	--	--	1.5	If equaled or exceeded	If exceeded on more than 1 day per year
		30 days	--	--	1.5	--		

Notes: All standards are based on measurements at 25° C and 1 atmosphere pressure.

National standards shown are the primary (health effects) standards.

The California 24-hour standard for SO<sub>2</sub> applies only when state 1-hour O<sub>3</sub> or 24-hour PM10 standards are being violated concurrently.



**Table 2. Calculated Thresholds for Submission of Environmental Documents to BAAQMD For Selected Land Use Categories**

Land Use Category	Size of Unit	Trip Generation Rate (T/SU)	Length (miles)	Avg. Trip Size Equiv. to 550 lb CO/day	Threshold Levels (Rounding & Judgement)
<b>Housing</b>					
Single Family	unit	10.1	6.2	194 units	200 units
Apartments	unit	5.7	6.2	336 units	300 units
<b>Parking</b>	space	6.0	6.2	274 spaces	250 spaces
<b>Shopping Center</b>					
Regional	1,000 ft <sup>2</sup>	40	5	58,000 ft <sup>2</sup>	60,000 ft <sup>2</sup>
Neighborhood	floor	86	2	70,000 ft <sup>2</sup>	(or 6 acres
Individual Store	area	48	3.7	67,000 ft <sup>2</sup>	of land area)
<b>Industry</b>					
Undifferentiated	acre	79	9.6	16 acres	15 acres
Mass Production	acre	93	9.6	13 acres	15 acres
Industrial Park	acre	64	9.6	20 acres	20 acres
Administration	acre	60	9.6	21 acres	20 acres
Warehouse	acre	81	6.6	22 acres	20 acres
Research & Develop.	acre	31	9.6	40 acres	40 acres
<b>Office Bldg</b>	1,000 ft <sup>2</sup>	15	6.2	126,000 ft <sup>2</sup>	100,000 ft <sup>2</sup>
<b>Government Bldg</b>	1,000 ft <sup>2</sup>	65	6.2	30,000 ft <sup>2</sup>	30,000 ft <sup>2</sup>
<b>Motel</b>	unit	10	5.4	221 units	200 units
<b>Restaurant</b>					
Full Service	seat	3	5.3	749 seats	700 seats
Fast Food	employee	75	3.7	43 employees	40 employees
Drive-in	1k ft <sup>2</sup>	553	5.2	4,200 ft <sup>2</sup>	4,000 ft <sup>2</sup>
<b>Theater</b>	seat	2.5	5.3	898	900 seats

Any facility attracting or generating more than 1,927 motor vehicle trips/day (969 vehicles, in and out) will be subject to BAAQMD review. It is appropriate to prepare an air quality impact assessment and to submit to BAAQMD environmental documents prepared for:

- all industrial and other sources with direct emissions of air contaminants which approach or exceed the BAAQMD thresholds for requiring Best Available Control Technology (BACT). See Regulation 2-2-301 for detailed listing.
- all airports, ports, major road and other transportation projects; sports stadiums; governmental actions affecting more than 50 acres;
- smaller projects under conditions discussed on page III-1 paragraph two.

Source: Air Quality and Urban Development Guidelines for Assessing Impacts of Projects and Plans. BAAQMD, November 1985. Page III-3.



The CAP anticipates that the region will come into compliance with the State CO standards by the mid-1990s. Currently, only San Francisco, San Jose, and Vallejo exceed the California ambient CO standards. The CAP also states that the Bay Area's air quality will continue to improve throughout the 1990s, but will not improve enough to meet the State ozone standard by 1997 (Bay Area Air Quality Management District, 1991).

## **II. SOURCES OF POLLUTANTS**

Pollutant sources are classified in terms of *point sources*, *mobile sources*, and *area sources*. Point sources are generated by a single site where a specific activity results in emission of known pollutants, such as the emissions expected from an industrial smokestack, electronic research and development facility, quarry or dump site. BAAQMD issues permits to landowners and operators who are responsible for these sites in order to limit and monitor point source emissions. Mobile sources are more difficult to regulate directly but refer to streets, highways, waterways, etc. where pollutants will be emitted by a number of motor vehicles along a specific route. The State's vehicle emission control regulations have had the greatest effect in regulating line sources. Area sources include all other emissions which can be expected from developed land including heating fuels, water heaters and furnaces, consumer products, fires in fireplaces, construction, demolition and agricultural operations. Local government can influence area and line sources through effective local land use, transportation, health, and safety policies. Appendix 2 provides an inventory of emissions by source, using the base year of 1987 and projecting through 2010.

## **III. TYPES OF POLLUTANTS AND THEIR PRESENCE IN MARIN COUNTY**

Due to favorable meteorological conditions in Marin and the absence of heavy industry, the ambient air quality throughout the county is excellent. However, the pollutants generated primarily through vehicle emissions in Marin are a growing concern locally and contribute to unhealthful conditions in other parts of the region.

Marin County has exceeded standards for the pollutants listed in Table 1 only in rare instances in past years. Motor vehicles are the largest source of emissions in Marin County and contribute to the regional air pollution problem. Table 4 reports the amount of pollutants emitted into the air in Marin County in 1987, 1990, 2010 (projected).



**Table 3. Number of Days On Which Federal or State Standards  
Were Exceeded at the San Rafael Monitoring Station**

<b>Pollutant</b>	<b>1978</b>	<b>1980</b>	<b>1982</b>	<b>1983- 1987</b>	<b>1988</b>	<b>1989</b>	<b>1990</b>
Carbon Monoxide	1	0	0	0	1	0	0
Ozone (O <sub>3</sub> )	2	0	0	0	0	0	0
Nitrogen Dioxide (NO <sub>2</sub> )	0	0	0	0	0	0	---
Sulfur Dioxide (SO <sub>2</sub> )	0	0	0	0	0	0	---
Total Suspended Particles (PM <sub>10</sub> )	0	0	0	0	2	8	4

Source: Bay Area Air Quality Management District, San Francisco, CA.

**Table 4. Marin County Emission Inventory Summary: 1987, 1990, 2010  
(Average Daily Emissions per Ton)**

Source Category	1987			1990			2010		
	ROG <sup>a</sup>	NO <sub>x</sub> <sup>b</sup>	PM <sub>10</sub> <sup>c</sup>	ROG	NO <sub>x</sub>	PM <sub>10</sub>	ROG	NO <sub>x</sub>	PM <sub>10</sub>
Fuel combustion	0.8	1.6	1.4	0.34	1.61	0.89	0.41	2.07	1.05
Waste burning	--	0.1	--	0.03	0.03	0.04	0.03	0.04	0.05
Solvent use	5.1	--	--	5.58	--	--	7.54	--	--
Petroleum processing	0.8	--	--	0.67	--	0.01	0.74	--	0.01
Industrial processes	0.4	--	0.5	0.33	--	0.52	0.36	0.01	0.66
Miscellaneous sources	<u>2.6</u>	--	<u>28</u>	<u>0.82</u>	--	<u>19.91</u>	<u>0.95</u>	--	<u>25.26</u>
Total stationary	9.6	1.7	30	7.77	1.64	21.37	10.04	2.13	27.03
On-road vehicles	14.00	16.0	1.3	8.33	11.70	1.12	5.21	11.13	1.10
Other mobile sources	<u>1.8</u>	<u>1.4</u>	<u>0.1</u>	<u>1.84</u>	<u>1.52</u>	<u>0.22</u>	<u>2.31</u>	<u>1.91</u>	<u>0.29</u>
Total mobile sources	15.8	17.4	1.4	10.17	13.22	1.34	7.52	13.04	1.39
Total Marin County	25.4	19.1	31.4	17.94	14.87	22.71	17.56	15.17	28.42

<sup>a</sup> Reactive organic gases.

<sup>b</sup> Nitrogen oxides.

<sup>c</sup> Particulate matter or dust particles equal to or less than 10 microns in diameter.

Sources: California Air Resources Board 1990, 1989b.



## A. CARBON MONOXIDE (CO)

Carbon monoxide is an odorless, colorless gas that is toxic in high concentrations and in enclosed places. Carbon monoxide levels are important to public health because CO combines with hemoglobin and reduces the amount of oxygen transported in the blood stream. Even relatively low concentrations of CO can significantly affect the amount of oxygen in the bloodstream. CO binds to hemoglobin 220-245 times more strongly than oxygen. Exposure causes fatigue, headache, confusion, dizziness, impairment of central nervous system functions, and aggravation of cardiovascular disease. State and Federal standards for CO are intended to keep it from combining with more than 1.5% of the blood's hemoglobin (U.S. Environmental Protection Agency, 1978, and the California Air Resources Board, 1982).

Carbon monoxide is formed by the incomplete combustion of fuels. While forest fires contribute to the natural concentration of carbon monoxide in the atmosphere, man-made sources contribute almost three times as much. Outdoor CO levels are a fairly reliable indicator of potential indoor CO levels. CO is not chemically reactive and is poorly soluble in water. Thus it is not absorbed onto surfaces or otherwise altered as it enters open doorways, open windows, or building ventilation systems.

The main source of man-made carbon monoxide is the automobile and other transportation emissions. Transport away from the emission source disperses and reduces pollutant concentrations. CO problems are usually localized and often the result of a combination of high traffic volumes and significant traffic congestion.

Data from previous studies suggest that CO problems occur primarily in the vicinity of major traffic arteries having significant amounts of commercial development. The presence of significant commercial development is an important contributing factor for two reasons. Parking lots for such developments represent a localized source of emissions that augments the CO emissions from vehicle traffic on adjacent roadways. Additionally, vehicles leaving major parking lots are likely to be in a cold start operating mode, resulting in higher CO emission rates than is typical for through traffic on major roadways.

A secondary man-made source of CO comes from combustion of fuel used for heating, fireplaces and wood stoves, electricity and industrial processes. Combustion of wastes and accidental fires in structures also generate unwanted man-made carbon monoxide.

Table 3 shows CO results for the San Rafael monitoring site, the only CO monitor located in Marin County. This monitor has not shown a violation of State or Federal CO standards during the past six years. Consequently, Marin County is classified as an attainment area for CO.

Meteorological conditions are also a significant factor affecting the development of CO problems. High CO levels develop primarily during winter months when periods of light winds or calm conditions combine with the formation of ground-level temperature inversions (typically in the evening through early morning period). These conditions result in reduced dispersion of vehicle emissions, allowing CO problems to develop and persist during hours when traffic volumes are declining from peak levels. Motor vehicles also exhibit increased CO emission rates at low air temperatures.

## **B. OZONE (O<sub>3</sub>)**

Ozone (O<sub>3</sub>) is a colorless, odorless gas. It is a public health concern because ozone is a respiratory irritant that increases susceptibility to respiratory infections and it also causes eye irritation. Ozone causes substantial damage to leaf tissues of crops and natural vegetation and damages many materials by acting as a chemical oxidizing agent. Problems from this pollutant are the cumulative result of regional development patterns, rather than the result of a few significant emission sources.

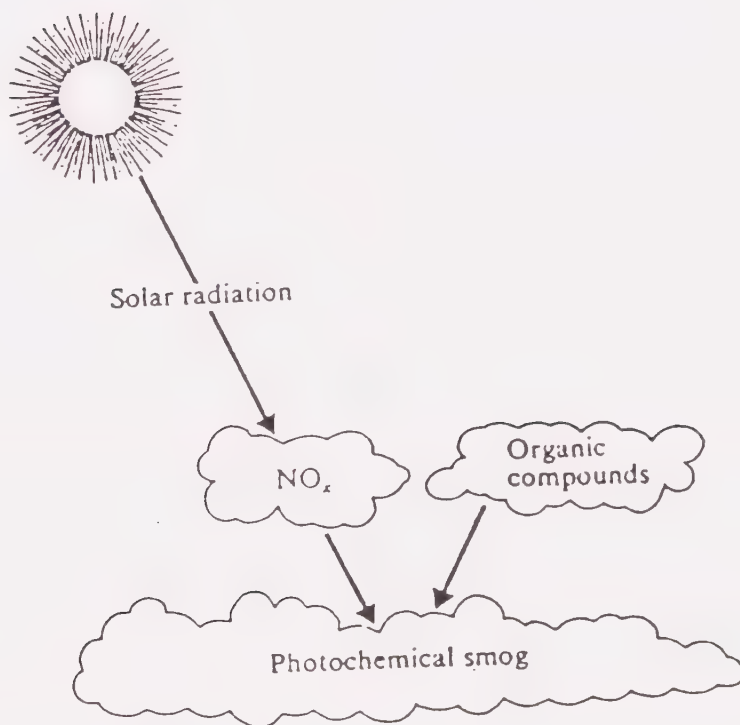
Unlike other pollutants, ozone is not emitted directly into the atmosphere from a source. Rather, it is the result of complex chemical reactions between hydrocarbons and oxides of nitrogen in the presence of ultraviolet rays from the sun. "Hydrocarbons," also known as "reactive organics" (ROG), are the organic compounds which are the precursors to ozone. The major sources of nitrogen (NO<sub>x</sub>) and hydrocarbons are combustion sources such as factories, refineries, motor vehicles, diesel and gasoline engines, and the evaporation of solvents and fuels. The 1-hour ozone standard for the State is 0.09 parts per million (ppm), by volume not to be exceeded. The Federal 1-hour ozone standard is 0.12 ppm, not to be exceeded more than three times in a 3-year period.

San Rafael is the site of the only ozone monitoring station in Marin County. The State air quality standard for ozone has been exceeded at the San Rafael monitoring station only 3 days in the past 6 years. Because other monitoring stations throughout the Bay Area air basin have recorded violations of the State and Federal ozone standard, the entire BAAQMD jurisdiction, including Marin County, has been designated a nonattainment area for the State and Federal ozone standards (California Air Resources Board, 1989). The nonattainment designation indicates that the ozone levels in the BAAQMD jurisdiction are a potential threat to public health.

Motor vehicles are the primary sources of NO<sub>x</sub> and ROG in Marin County and therefore are the County's primary contributors to regional ozone concentrations.



**Figure 1. Photochemical Smog with High Ozone Content is Produced from Nitrites and Organic Compounds in the Presence of Sunshine**



### C. NITROGEN DIOXIDE (NO<sub>2</sub>)

Nitrogen dioxide (NO<sub>2</sub>) is a reddish-brown gas which is toxic at concentrations much higher than found in the region's air. It occurs as a by-product of combustion and is also a product of nitric oxide reacting in the presence of sunshine. When found with ozone, it is responsible for the "brown cloud" appearance of smog from a distance. Nationally, the major sources of nitrogen dioxide are transportation (56%), industry (21%), electric power, and gas generation (15%).

The adverse effect of this gas on humans includes risk of acute and chronic respiratory disease upon exposure.

### D. SULFUR DIOXIDE (SO<sub>2</sub>)

Sulfur dioxide (SO<sub>2</sub>) is a colorless gas. It is created by the combustion of sulfur-containing fuels. This substance is known to oxidize to sulfur trioxide which combines with moisture in the atmosphere to form sulfuric acid, a major component in "acid rain" and "acid fog." Sulfur dioxide damages and irritates lung tissue, aggravates asthmatic symptoms and cardio-pulmonary disease. Concentrations in the Bay Area are much lower than the Federal and State standards.

Sources of this gas in the Bay Area are industrial (45%), mobile (45%) and combustible fuel (11%) (Source: BAAQMD). The concentration of this gas measured in Marin County in 1982 was one ton per day, exclusively from transportation sources.

### E. FINE PARTICULATES (P.M.10)

Suspended particulates are particles of dust, soot, aerosols and other solid and liquid matter which are small enough to remain suspended in the air for a long period of time yet are respirable. Natural matter such as wind-blown dust and pollen constitutes a portion of the total particulate concentration. However, man-made sources of P.M.10 include, but are not limited to, road dust from motor vehicles, construction, and industry.

These particles are usually measured in micrograms per cubic meter (ug/m<sup>3</sup>) reported as fine suspended particulates per 24-hour period or on an annual geometric mean basis. The California standards for suspended particulates are far more restrictive than the Federal standards (see Table 1).

Standards now include only smaller particulate matter of less than 10 microns in diameter (P.M.10) because they can be breathed more easily and thus pose the greatest



health risk. Suspended particulates are known to aggravate chronic disease and heart/lung disease symptoms. They also contribute to reduced visibility and soiling of surfaces.

BAAQMD reports that Marin County produces 23 tons per day of total suspended particulates, mostly from road dust. It has not yet been estimated what portion constitutes P.M.10.

#### **IV. SENSITIVE RECEPTORS**

BAAQMD identifies sensitive receptors as facilities with a number of individuals who are highly susceptible to the adverse effects of air pollutants. These facilities include: hospitals, clinics, schools, playgrounds, child care centers, and convalescent and retirement homes. Figure 2 shows the location of sensitive receptor sites within unincorporated Marin County.

Receptor population groups include children, the elderly, the acutely ill, and the chronically ill. Those individuals with cardio-respiratory diseases are the most susceptible. The presence of children and infirm and elderly people in most neighborhoods means that most residential areas should be considered sensitive receptors as well.

Local plans and policies can contribute to the improvement of air quality conditions near sensitive receptors by:

- Not allowing point sources to locate near existing or future receptor sites; and,

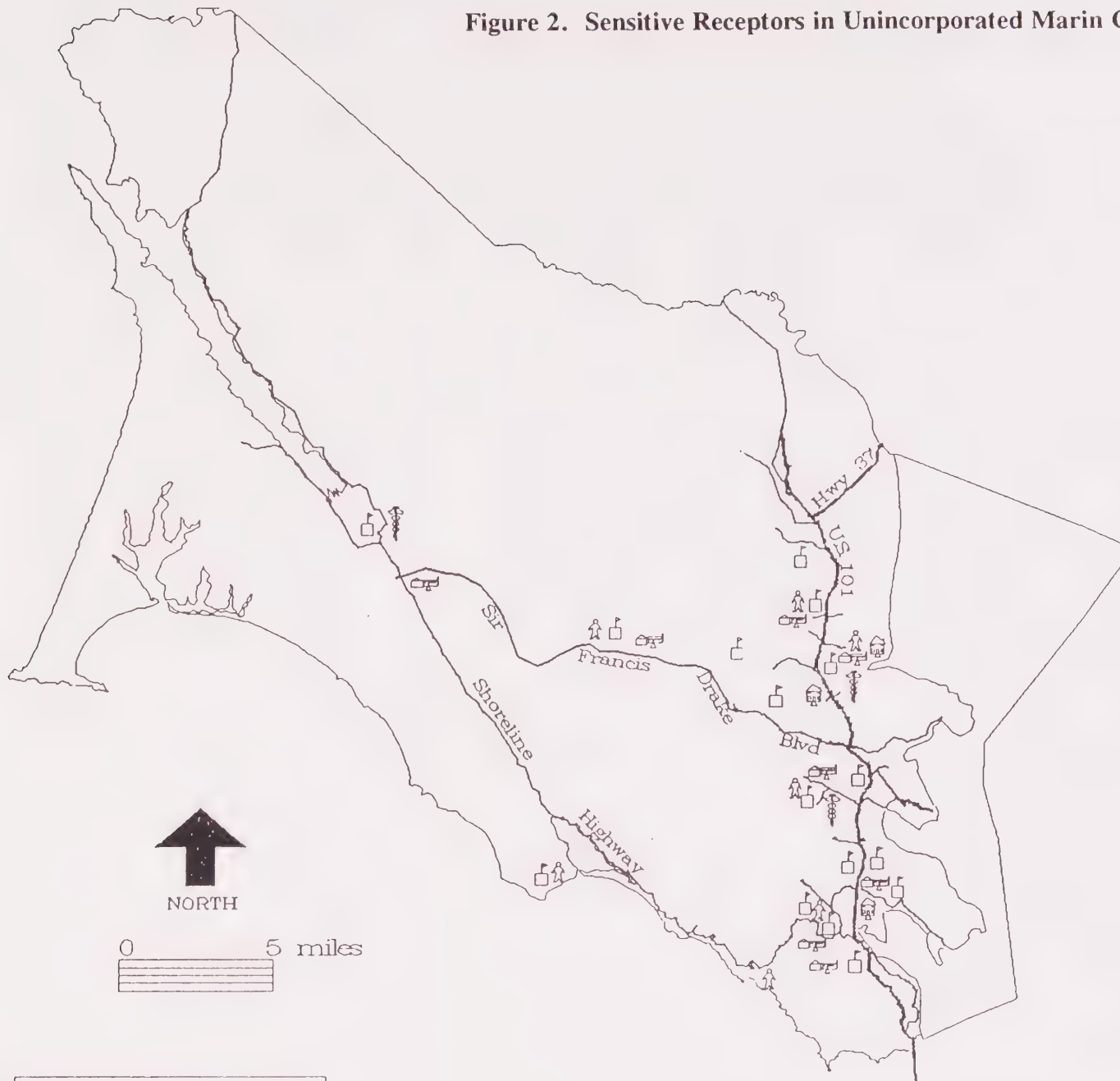
- Not allowing new receptor facilities to locate in areas where air quality problems may occur.

In Marin County, the proximity of some sensitive receptors to heavily traveled roads may expose these populations to higher concentrations of carbon monoxide and nitrogen dioxide, especially during and after the commute rush hours. Considering the prevailing wind patterns in Marin, receptors could be protected by locating them upwind of and at a distance from major transportation arteries.






#### **V. METEOROLOGICAL FACTORS**

The coastal climate in Marin is largely responsible for the dispersion of many pollutants generated in the County, resulting in a very low probability that standards will be exceeded locally.

Figure 2. Sensitive Receptors in Unincorporated Marin County



## LEGEND

-  Child Care
-  Retirement Home
-  School
-  Medical Facility
-  Convalescent Home

This map was developed for General Plan purposes.  
The County of Marin is not responsible or liable  
for use of this map beyond its intended purpose.





These climatic factors include highly variable offshore and inland temperatures resulting in constant winds, a marine layer of fog which lifts in the morning hours during the summer and heavy winter precipitation relative to other parts of the Bay Area.

The County's topographic pattern, especially in urban areas, may be described as a series of low ridges with an east-west alignment, which correspond to the primary direction of the coastal winds year round. The combination of wind direction and topography allows for constant scouring of the ambient air in the heavily populated valleys. This fortunate combination results in extremely high air quality most of the time.

The "inversion" is defined as reverse of the typical vertical temperature structure, i.e., when cooler temperatures occur near the ground and higher temperatures occur above. When nitrogen dioxide or particulates are present, inversions occasionally result in a visible layer of pollution containment. "Subsistence" inversions occur in Marin most frequently between April and October and are attributable to a delayed lifting of the marine layer of clouds which penetrate inland from the coast on a near-nightly basis during those months. There can also be "radiation inversions" in mid-winter which exacerbate carbon monoxide and particulate problems. But even these conditions have not caused standards to be exceeded to any great extent in Marin County.





**APPENDIX 1. SENSITIVE RECEPTORS IN  
UNINCORPORATED MARIN COUNTY (1988)**





Parcel #	Facility Name	Address
18005323	Gallinas Village Nursery School	635 Adrian Way
18005323	Happy House Toddler Playgroup Co-op	635 Adrian Way
16005112	Loma Verde School	399 Alameda de la Loma
01808522	Montessori School of Yvonne Van Boeckel	317 Auburn Street
16414108	St. Mark's School	375 Blackstone Drive
02206020	Marin General Hospital	250 Bon Air Road
17616202	Sleepy Hollow Nursery School	1317 Butterfield Road
05214038	Manzanita Children's Center	620 Drake Avenue
05211203	Head Start-Marin	825 Drake Avenue
05214038	Children's Cultural Center of Marin	620 Drake Avenue
19024110	Bolinas Child Center	270 Elm Road
04906119	Tom Deane Home, Inc.	573 Fairview Avenue
18007403	Hacienda Rest Home #3	834 Hacienda Way
01800704	Hacienda Rest Home #1	826 Hacienda Way
05106229	Mt. Tamalpais Primary School	100 Harvard Avenue
05106230	Mt. Tamalpais Primary School	100 Harvard Avenue
05104601	Mt. Tamalpais Primary School	100 Harvard Avenue
16414105	Children's Garden Group Home #1	2647 Heatherstone Drive
16446001	Dixie School	1175 Idylberry Drive
16402210	Marin Waldorf School	755 Idylberry Road
16402210	Acorns to Oaks Child Care Center	755 Idylberry Road
16408213	Briggin Home #2	573 Idylberry Road
16405109	Terra Linda Christian Home #3	1254 Idylberry Road
16409513	Terra Linda Christian Home #2	598 Kernberry Drive
18006312	Mountain View Guest House	109 La Brea Way
16425410	Marin Formative Center	2000 Las Gallinas Avenue
16426028	Miller Creek School	2255 Las Gallinas Avenue
07411508	Kentfield After School Program	25 McAllister Avenue
07411508	Anthony C. Bacich School	25 McAllister Avenue
16410105	Miller Creek Home	588 Miller Creek Road
04716107	Tam Creek School	305 Montford Avenue
04716107	Over the Rainbow Early Learning Center	305 Montford Avenue
04713230	Full Circle Group Home #7	407 Montford Avenue
04716107	Homestead Valley Child Care Center	305 Montford Avenue
16441303	Briggin Home	80 Mt. Tenaya Drive
03407206	West Family Home	6 Kneel Way
05208306	Mitchell Family Home	50 Park Circle
17926184	Rainbow House	20 Rainbow Road
04313207	S Alexander Haven	120 Ricardo Road

Parcel #	Facility Name	Address
18006318	Parfitt's Rest Home #1	675 Rosal Way
18006319	Parfitt's Rest Home #2	665 Rosal Way
18006321	Parfitt's Rest Home #3	645 Rosal Way
18112142	Marin Jewish Comm Center Infant/Toddler	251 N. San Pedro Road
18012142	Marin Jewish Comm Center Infant/Toddler	251 N. San Pedro Road
18012525	Old Gallinas Children's Center	251 N. San Pedro Road
18015128	Barbara Smith Home	601 N. San Pedro Road
18012125	Marin Jewish Comm Center Nursery School	200 N. San Pedro Road
17931230	ABC Nursery School	138 N. San Pedro Road
17931229	ABC Nursery School	138 N. San Pedro Road
18028101	Brandeis Hillel Day School	170 N. San Pedro Road
18028122	Rafael Convalescent Hospital	234 N. San Pedro Road
18028108	Marin School for Learning	160 N. San Pedro Road
19922109	Muir Beach Child Care Center	19 Seacape Drive
03309218	Mill Valley Co-op Nursery	51 Shell Road
05006145	Sage Home	542 Shoreline Highway
16826001	West Marin Montessori School	6350 Sir Francis Drake
16826001	Lagunitas Elementary School	6350 Sir Francis Drake
16826001	San Geronimo Valley Day Care Center	6350 Sir Francis Drake
04314216	Strawberry Point School	117 E. Strawberry Drive
03406104	Ross Academy Montessori School-Mill Valley	7 Thomas Drive



**APPENDIX 2. INVENTORY OF EMISSIONS BY SOURCE:  
1987, 1990, 2000, 2010**





BAY AREA AIR QUALITY MANAGEMENT DISTRICT  
Marin

POINT & AREA SOURCES

Base Year 1987

	1 9 8 7 Tons/Day					
	Part	TOG	ROG	NOx	SO2	CO
<b>INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES</b>						
PETROLEUM REFINING FACILITIES	.00	.00	.00	.00	.00	.00
CHEMICAL MANUFACTURING FACILITIES	.00	.02	.02	.00	.00	.00
OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES	.87	26.46	.39	.00	.00	.00
Sub total	.87	26.48	.60	.00	.00	.00
<b>PETROLEUM PRODUCT/SOLVENT EVAPORATION</b>						
PETROLEUM REFINERY EVAPORATION	.00	.00	.00	.00	.00	.00
FUELS DISTRIBUTION	.00	1.74	.84	.00	.00	.00
OTHER ORGANIC COMPOUNDS EVAPORATION	.00	3.15	3.02	.00	.00	.00
Sub total	.00	4.90	3.87	.00	.00	.00
<b>COMBUSTION - STATIONARY SOURCES</b>						
FUELS COMBUSTION	1.49	1.70	.83	1.62	.06	9.16
BURNING OF WASTE MATERIAL	.04	.03	.02	.04	.01	.10
Sub total	1.53	1.73	.85	1.65	.07	9.26
<b>COMBUSTION - MOBILE SOURCES</b>						
OFF-HIGHWAY MOBILE SOURCES	.20	2.37	2.26	3.05	.25	18.75
AIRCRAFT	.00	.04	.04	.01	.00	.85
ON ROAD MOTOR VEHICLES	2.22	14.50	13.37	16.22	1.22	99.33
Sub total	2.42	16.90	15.67	19.27	1.47	118.93
<b>MISCELLANEOUS OTHER SOURCES</b>						
	48.71	25.70	21.52	.02	.00	1.46
Grand total -	53.53	75.71	42.52	20.95	1.53	129.65 (Tons/day)

Program to Print: SAIPR1

Source: Bay Area Air Quality Management District, 1991.

BAY AREA AIR QUALITY MANAGEMENT DISTRICT  
Marin

POINT & AREA SOURCES

Base Year 1987

1 9 9 0

Tons/Day

	Part	TOG	ROG	NOx	SO2	CO	
<b>INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES</b>							
PETROLEUM REFINING FACILITIES	.00	.00	.00	.00	.00	.00	
CHEMICAL MANUFACTURING FACILITIES	.00	.02	.02	.00	.00	.00	
OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES	.94	13.83	.40	.00	.00	.00	
Sub total	.94	13.85	.42	.00	.00	.00	
<b>PETROLEUM PRODUCT/SOLVENT EVAPORATION</b>							
PETROLEUM REFINERY EVAPORATION	.00	.00	.00	.00	.00	.00	
FUELS DISTRIBUTION	.00	1.78	.88	.00	.00	.00	
OTHER ORGANIC COMPOUNDS EVAPORATION	.00	2.81	2.67	.00	.00	.00	
Sub total	.00	4.59	3.55	.00	.00	.00	
<b>COMBUSTION - STATIONARY SOURCES</b>							
FUELS COMBUSTION	1.54	1.75	.85	1.65	.06	9.43	
BURNING OF WASTE MATERIAL	.04	.03	.02	.04	.01	.11	
Sub total	1.58	1.78	.88	1.69	.07	9.54	
<b>COMBUSTION - MOBILE SOURCES</b>							
OFF-HIGHWAY MOBILE SOURCES	.21	2.46	2.35	3.23	.26	19.56	
AIRCRAFT	.00	.04	.04	.01	.00	.91	
ON ROAD MOTOR VEHICLES	2.47	11.37	10.41	14.62	1.24	85.34	
Sub total	2.68	13.87	12.80	17.85	1.51	106.01	
<b>MISCELLANEOUS OTHER SOURCES</b>							
	52.36	26.06	21.64	.02	.00	1.44	
Grand total -	57.55	60.15	39.28	19.56	1.58	116.99	(Tons/day)

Program to Print: SAIPR1



BAY AREA AIR QUALITY MANAGEMENT DISTRICT  
Marin

POINT & AREA SOURCES

Base Year 1987

2 0 0 0  
Tons/Day

	Part	TOG	ROG	NOx	SO2	CO
<b>INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES</b>						
PETROLEUM REFINING FACILITIES	.00	.00	.00	.00	.00	.00
CHEMICAL MANUFACTURING FACILITIES	.00	.02	.02	.00	.00	.00
OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES	1.19	13.51	.43	.00	.00	.00
Sub total	1.19	13.53	.45	.00	.00	.00
<b>PETROLEUM PRODUCT/SOLVENT EVAPORATION</b>						
PETROLEUM REFINERY EVAPORATION	.00	.00	.00	.00	.00	.00
FUELS DISTRIBUTION	.00	2.03	.89	.00	.00	.00
OTHER ORGANIC COMPOUNDS EVAPORATION	.00	2.88	2.74	.00	.00	.00
Sub total	.00	4.91	3.63	.00	.00	.00
<b>COMBUSTION - STATIONARY SOURCES</b>						
FUELS COMBUSTION	1.65	1.88	.91	1.85	.06	10.12
BURNING OF WASTE MATERIAL	.04	.03	.03	.04	.01	.12
Sub total	1.69	1.92	.94	1.89	.08	10.24
<b>COMBUSTION - MOBILE SOURCES</b>						
OFF-HIGHWAY MOBILE SOURCES	.24	2.56	2.46	3.88	.31	23.05
AIRCRAFT	.00	.05	.05	.01	.01	1.12
ON ROAD MOTOR VEHICLES	2.27	6.20	5.65	9.44	.59	45.62
Sub total	2.52	8.81	8.16	13.32	.91	69.80
MISCELLANEOUS OTHER SOURCES	61.27	26.60	21.62	.02	.00	1.45
Grand total -	66.66	55.76	34.81	15.23	.98	81.48 (Tons/day)

Program to Print: SAIPR1

BAY AREA AIR QUALITY MANAGEMENT DISTRICT  
Marin

POINT & AREA SOURCES

Base Year 1987

2 0 1 0  
Tons/Day

	Part	TOG	ROG	NOx	SO2	CO
<b>INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES</b>						
PETROLEUM REFINING FACILITIES	.00	.00	.00	.00	.00	.00
CHEMICAL MANUFACTURING FACILITIES	.00	.03	.02	.00	.00	.00
OTHER INDUSTRIAL/COMMERCIAL PROCESSES/FACILITIES	1.49	13.57	.48	.00	.00	.00
Sub total	1.49	13.60	.50	.00	.00	.00
<b>PETROLEUM PRODUCT/SOLVENT EVAPORATION</b>						
PETROLEUM REFINERY EVAPORATION	.00	.00	.00	.00	.00	.00
FUELS DISTRIBUTION	.00	2.32	.95	.00	.00	.00
OTHER ORGANIC COMPOUNDS EVAPORATION	.00	3.15	3.01	.00	.00	.00
Sub total	.00	5.47	3.96	.00	.00	.00
<b>COMBUSTION - STATIONARY SOURCES</b>						
FUELS COMBUSTION	1.76	2.01	.98	2.04	.07	10.81
BURNING OF WASTE MATERIAL	.05	.04	.03	.04	.01	.13
Sub total	1.81	2.05	1.01	2.08	.08	10.94
<b>COMBUSTION - MOBILE SOURCES</b>						
OFF-HIGHWAY MOBILE SOURCES	.28	2.67	2.58	4.43	.36	26.21
AIRCRAFT	.00	.06	.05	.01	.01	1.29
ON ROAD MOTOR VEHICLES	2.40	5.59	5.14	9.36	.59	30.38
Sub total	2.67	8.32	7.77	13.80	.95	57.88
<b>MISCELLANEOUS OTHER SOURCES</b>						
	67.84	27.79	22.07	.02	.00	1.46
Grand total -	73.81	57.23	35.30	15.90	1.03	70.28 (Tons/day)

Program to Print: SAIPR1



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